

CHAPTER 3

ENVIRONMENTAL RESOURCES

3-1. Environmental Requirements.

a. General. As noted in Table 2-2, the "Environment" is a consideration in each coastal shore protection project category. The environmental effects of all project alternatives must, by law as well as normal engineering considerations, be evaluated. Opportunities for incorporating environmental considerations and enhancements in coastal shore protection projects should be investigated.

b. Policies. The planning, design, construction, and operation and maintenance activities of coastal shore protection projects must be consistent with national environmental policies. Those policies require that such activities be done to the extent practicable in such a manner as to be in harmony with the human and natural environment, and to preserve historical and archaeological resources. Corps project development is documented by a series of studies, each being more specific than the previous study. The series of reports produced for a project varies by Corps District and Division and through time due to scientific judgment, the unique conditions specific to each project, and changing regulations. In general, an initial evaluation (or reconnaissance) report and a feasibility (or survey) report are prepared prior to congressional project authorization. Refer to ER 1105-2-10, for a description of this planning process. Environmental studies are included along with engineering, economic, and other types of analysis (ER 1105-2-50).

c. Statutes and Regulations. Complying with Federal statutes, executive orders and memoranda, and Corps regulations requires careful study of existing environmental conditions and those expected to occur in the future with and without shore protection. Principal environmental statutes/regulations that are applicable to Corps coastal shore protection projects are listed in Appendix C.

d. Environmental Studies. During each stage of project planning, design and construction, major environmental concerns and corresponding information needs should be identified. Forecasting of information needs is necessary in order to schedule sufficient time for field data collection, physical or numerical modeling if needed, and other needs. Scheduling of field studies should allow for administrative time related to contract preparation, contractor selection, report and NEPA document preparation, review of findings, and coordination or consultation with concerned Federal agencies and the interested public.

(1) Checklist of studies. The following checklist consists of some of the environmental factors that should be considered for coastal shore protection projects. Environmental factors selected for study will depend upon the type project being considered. This checklist is not all inclusive and not all factors are appropriate for all projects.

- (a) Determine the bounds of the project areas.
  - (b) Characterize existing environmental (physical, ecological, cultural, economic conditions at a project site.
  - (c) Be aware of other planned construction activities likely to be associated with the Federal project and evaluate their cumulative impacts.
  - (d) Evaluate project effects on long-shore sedimentation processes, circulation patterns, currents, and wave action.
  - (e) Evaluate project effects on water quality, including characterization and testing of sediments as required in Section 103 of the Ocean Dumping Act (PL 92-532) or Section 404 of the Clean Water Act (PL 92-500) evaluations.
  - (f) Evaluate the no action alternative and nonstructural solutions.
  - (g) Evaluate project effects on erosion and deposition.
  - (h) Evaluate all reasonable and practicable construction alternatives (construction equipment, timing, etc.).
  - (i) Evaluate effects of the final array of alternative plans on significant biological, aesthetic, cultural and recreational resources.
  - (j) Describe relationships of each plan to the requirements of environmental laws, executive orders, Federal permits and state and local land use plans and laws.
  - (k) Include feasible designs, operational procedures, and appropriate mitigation measures to reduce or avoid adverse environmental impacts in the preferred plan and alternatives evaluated.
  - (l) Coordinate with other agencies, the public, and private groups.
  - (m) Plan and design an environmental monitoring program as needed.
- (2) Critical issues. Time and money constraints will generally dictate the level and scope of investigation and data collection for all environmental areas of interest. Therefore, the most significant environmental issues identified by the public and resource agencies during scoping should be investigated. It is essential that the issues investigated fully account for all significant effects of a project and that a realistic balance be achieved between the study requirements and funds available. The addition of factors determined at a later date will increase the time, cost, and expertise required for the study.

Chapters 4, 5, and 6 of this manual identify major environmental considerations associated with alternative shore protection solutions. Criteria for determining significant issues include statutory requirements, executive orders, agency regulations and guidelines, and other institutional standards of regional and local interest. (see Appendix C).

(3) Environmental monitoring. The Council on Environmental Quality regulations at 40 CFR 1505.3 state that agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases and upon request, make available to the public the results of relevant monitoring. The 40 CFR 1505.2 also states that a monitoring and enforcement program shall be adopted and summarized where applicable. The term "environmental monitoring" as defined in ER 200-2-2 is that oversight activity necessary to ensure that the decision, including required mitigation measures, is implemented. Environmental monitoring as discussed in Chapter 7 of this manual refers to the overall process of data collection, management, analysis and interpretation of short and long term changes over the life of the project and analysis are discussed in Chapter 7 of this manual.

(4) Each study must have well-defined, detailed objectives prior to field data collection. The study design should include a rationale for hypotheses to be tested, the variables to be monitored, techniques and equipment to be used, sample station locations and frequencies, and data storage and analysis. Monitoring may extend beyond water quality and ecological studies and include monitoring noise, emission from equipment engines, cultural resources, archeological resources, etc., if deemed appropriate.

(a) Environmental studies during early stages of project formulation should emphasize identification of resources, development of an evaluation framework, and collection of readily available information for all potential alternatives. Resources likely to be impacted should be investigated, and additional data needs should be identified.

(b) Detailed analysis of a project occurs after evaluations narrow the range of specific alternatives to the most feasible (usually three or four) which have been selected for study. Beneficial and adverse environmental effects of each alternative should be quantified where possible or qualified in adequate detail so they can be included with the economic and technical analysis to compare and select the plan that maximizes NED benefits. Although a preferred alternative can be identified at this stage, formal selection of an alternative for construction must await the completion and agency review of the Environmental Impact Statement or Environmental Assessments. In this way the Corps, the public, and outside agencies have the benefit of a full evaluation of all feasible alternatives and a comparison of them by the lead agency. Post-construction monitoring, if authorized, should also be done to verify the impact predictions made during without project analysis. Where monitoring reveals the presence of unexpected impacts, measures should be considered to minimize the impacts.

3-2. Environmental Resource Categories. The remainder of this chapter summarizes the environmental resource categories that should be considered in evaluating the coastal shore protection alternatives. The six categories are physical, water quality, biological, recreational, aesthetic, and cultural.

3-3. Physical.

a. General. The physical modifications of the environment from coastal shore protection projects can result in both desirable and undesirable impacts. Many adverse impacts can be avoided by evaluating alternatives for siting and design. Consideration of physical impacts must occur during both the design stage and impact assessment stage.

b. Physical Design Considerations. Structural and, to a lesser extent, nonstructural measures have the potential of altering the hydrodynamic regime (circulation) and the hydraulic and wave energy conditions of the project area. Furthermore, construction frequently alters the shoreline configuration and/or bathymetry at the project site and occasionally up or down coast, by modifying the littoral transport system. In many instances these modifications are the objective of the design process. The purpose of a shoreline breakwater project is to reduce wave energy entering a harbor, marina, or other facilities. Groin projects and jetty construction result in modification of the littoral transport regime. If the project is not properly designed, adverse physical impacts, such as changes in shoreline configuration (shore erosion) or changes in bathymetry (navigation channel infilling), may occur. These impacts should be identified during the impact assessment stage and, if necessary, the project redesigned or relocated to minimize unwanted effects, such as excessive maintenance dredging and beach nourishment.

c. Physical Impact Assessment. Physical impacts can occur on both a short-term and long-term basis. Short-term impacts are generally construction related (i.e., short sections of a beach may be temporarily restricted during the fill and grading operations). During a beach nourishment project or dune construction, sands can become compacted altering transport phenomena. Physical effects from construction of breakwaters, jetties, groins, piers, or other nearshore structures stem from rock placement, jetting or driving piles, dredging to a solid bed or required depth, and other on site construction activities. Following the completion of these activities, impacts usually diminish rapidly (Naqvi and Pullen 1982, Van Dolah et al. 1984). Long-term impacts may be more important and more difficult to predict. Several tools will help in assessing potential adverse impacts: interviews with long-time residents, review of old aerial photos, on site monitoring, case studies of similar projects numerical models, and physical models. Using any or all of these tools, an evaluation of potential changes in circulation patterns, flushing conditions, and sediment transport phenomena should be

completed. Other studies of physical factors may be warranted on a case-by-case basis.

### 3-4. Water Quality.

a. General. Unlike physical impacts, water quality impacts involve changes in the water column's characteristics rather than changes in shoreline configuration or local bathymetry. Again the impacts are manifested on both a short-term and long-term basis.

b. Water Quality Design Considerations. The construction process is often responsible for increases in local turbidity levels, changes in salinity, releases of toxicants or biostimulants from fill materials, introduction of petroleum products, and/or the reduction of dissolved oxygen levels. These impacts can be minimized by modifying or selecting specific construction practices, carefully selecting fill materials, and in some instances by construction scheduling. These impacts are short-lived, and ambient water quality conditions will rapidly return unless long-term changes in the hydrodynamics and hydraulics have occurred. It is these long-term impacts that must be identified during the design process. In addition to the general impacts of the selected alternatives (whether structural or nonstructural), the proposed design specifications of any selected alternative also have the potential for affecting water quality. For example, the design of an off-shore breakwater (length, height, water depth, spacing) will greatly influence its impact on circulation and flushing and thus its impact on water quality.

c. Water Quality Impact Assessment. The long-term impact on water quality of nonstructural alternatives, i.e., planting beach grasses for dune stabilization, marsh grasses for bank stabilization, and seagrasses for bottom sediment stabilization, is generally negligible, whereas structural alternatives have a range of potential impacts. The range is a function of the location, size, and type of structure. In general, groins have the least potential for water quality impacts. Because groins change local patterns of water circulation, some changes in specific water quality parameters may occur, but these impacts are minimal for most groin projects. The water quality effects of bulkheads and seawalls are similar in that both will reduce erosion of the backshore and decrease local levels of suspended solids. Revetments, similarly to bulkheads and seawalls, may promote erosion of the foreshore and increase levels of suspended solids but to lesser extent. On the other hand, these structures may reduce overall levels of suspended solids by preventing erosion of uplands and backshore materials. Jetties and breakwaters have the greatest potential impact on circulation and flushing. The placement of jetties may not only alter circulation patterns and flushing conditions, as well as erosion and deposition patterns, but may also alter both river outflow and tidal conditions. These impacts may be of consequence well into the estuary and may have widespread effects, such as

changing salinity and circulation patterns. Breakwaters, by definition, are wave energy barriers designed to protect landforms or harbor-behind them. These off-shore structures also often influence circulation and flushing action in their lee. If the breakwater is constructed to form a semienclosed basin for use as a harbor or marina, the flushing conditions of the project area may be dramatically altered. Assessment and evaluation of water quality impacts must begin in the planning stage and continue at least through the design stage. Postconstruction monitoring may also be recommended to provide feedback for future projects.

d. Other Contaminants. Activities involving sediments or other construction materials known to contain chemical toxins should be conducted with special precautions to avoid unnecessary chemical release into the water body. Of particular concern would be potential introduction of chemical agents either during preparation, application, or cleanup of construction equipment. Chemical cleaning agents may also contain toxic compounds. Little is known about the potential affects of these compounds on aquatic organisms even in trace amounts. However, chemicals may acutely or chronically affect sensitive life history stages of fishes and shellfishes through: sorption onto eggs, causing reduced survival rates and hatching; impaired osmoregulatory ability, causing delayed development or mortality; or impaired sensory ability, affecting feeding, movement, or predator avoidance (Cairns 1968, Sindermann et al. 1982). Olsen (1984) provides a good general review of the literature on the availability and bioaccumulation of heavy metals, petroleum hydrocarbons, synthetic organic compounds, and radionuclides in sediments. Specific information on toxicity, sublethal effects and bioaccumulation of selected chemical compounds is given by Eisler (1985a-d, 1986a-b). Any release of potentially toxic chemical substances into the water should be particularly avoided during periods when the area is being utilized by migratory species and/or juvenile forms and during periods of harvest of nearby commercially important shellfishes.

### 3-5. Biological.

a. General. Nearshore marine and estuarine biological systems are diverse and complex. Shore protection projects may benefit one or more components of the biological system while adversely impacting others. Biological assessments of shore protection projects are used to predict the kind of ecosystem and importance, spatial extent, and severity of expected biological changes. In practice, analysis usually focuses upon species of commercial or recreational importance; rare, threatened, or endangered species; and sensitive or highly productive habitats.

#### b. Biological Design Considerations.

(1) The construction of shore protection measures usually produces short-term physical and water quality disturbances. These perturbations

directly impact biological communities and may result in long-term impacts. For example, some ecosystems damaged by construction or water quality degradation may recover slowly and take years to achieve preconstruction levels of development. Many of these impacts are unavoidable. However, construction activities can often be timed to avoid critical events such as fish or shellfish migrations or shorebird nesting. Construction activities also can often be located to avoid sensitive areas.

(2) Coastal structures alter bottom habitats by physical eradication and in some cases by deposition or scour. However, certain hard structures often create a highly productive, artificial reef type habitat. The type of material used to build a structure and the surface area of the structure will influence the quality of the newly created habitat.

(3) Some structures, which are connected to the shore and extend some distance seaward, may potentially interfere with the migration of certain fish and shellfish. To alleviate these concerns the structure may be modified to include gaps or shortened in length, or located outside the path of the migrations.

(4) Following construction, some remedial measures can be used to minimize biological impacts. For example, plant communities such as seagrass, beachgrass, and marsh grasses can be replanted following construction.

(5) Noise pollution from dredging or other activities may also be a major concern when in the proximity of bird nesting sites (Buckely and Buckely 1977). However, breeding activities are seasonal, and disturbance can be avoided by scheduling the operations during nonusage periods.

**C. Biological Impact Assessment.** The assessment of biological impacts must begin very early in the planning process. Some types of biological studies tend to be time consuming and often require data collection over an extended period of time. Early identification of specific biological issues is critical. Chapter 7 provides valuable information on the conduct of biological studies when important issues have been established. Often a key issue is possible siting of a project in a valuable biological area. If the ecosystem can be located and mapped early, it might be possible to move the project elsewhere to avoid the impacts, or redesign the project to reduce impacts.

(1) Habitat modification. All shore protection projects result in some modification of coastal habitats. Beach nourishment results in smothered benthic communities, although the recovery of these communities following nourishment is reported to be generally rapid (Naqvi and Pullen 1982). Structures provide a permanent alteration of the bottom. In some cases, the tradeoff made in replacing "soft" (mud or sand) bottom habitat

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with "hard" (rock, at least in rubble mound structures) bottom habitat has generally been viewed as a beneficial impact associated with coastal structures where diversity is desired (Van Dolah et al. 1984). Such habitat modification is typically not a major biological impact issue except when highly productive habitats such as coral reefs, seagrass beds, and spawning and nesting areas are involved.

(2) Fish migration. The impact of coastal structures on fish and shellfish larval migration has been raised as a biological issue. Early life history stages of many important commercial and sport fishes and shellfishes are almost entirely dependent on water currents for transportation between off-shore estuarine spawning grounds and nursery areas. Some coastal structures (inlet jetties in particular) may interfere with this migration process by modifying currents. However, the extent of a problem of this nature will depend upon a case-by-case evaluation of each site. Similar impacts have been associated with jetties and breakwaters on migrations of juvenile and adult fishes and shellfishes. This issue has been raised primarily in association with anadromous fishes in the Pacific Northwest. Conclusive evidence supporting these concerns has not been provided.

(3) Predation pressure. Coastal rubble mound structures provide substrate for the establishment of artificial reef communities. As such, jetties and breakwaters serve as a focal point for congregations of some types of fishes and shellfishes which feed or find shelter there. This condition has also generated a concern by resource agencies, again largely associated with projects in the Pacific Northwest, that high densities of predators in the vicinity of jetties and breakwaters pose a threat to egg, larval, and juvenile stages of important species. Conclusive evidence demonstrating the presence or absence of a significant impact is currently unavailable and will be extremely difficult to establish. It is unwarranted in any case to apply generalizations, and evaluations must be conducted on a site specific basis. For example, examination of existing similar structures nearby the proposed project site could provide clues on the type and extent of marine organism development on jetties, breakwaters, and other rubblemound structures.

### 3-6. Recreational.

#### a. General.

(1) Requirements. Recreation development requires cost sharing by a local sponsor. Refer to EP 1165-2-1 for cost-sharing policies. Additional basic requirements for recreation developments include:

- (a) Sufficient demand to ensure utilization of the facility.
- (b) Publicly controlled sites, including access routes.

(c) Provisions for prevention of vandalism.

Refer to ER 1105-2-20 and Appendix D of ER 1110-2-400 for a description of the types of recreation facilities eligible for Federal cost sharing. In general, eligible facilities are those not ordinarily provided by private enterprise or on a commercial or self-liquidating basis. In addition to these regulations, feature selection is also controlled by project site characteristics.

(2) Structures. The recreational potential of engineering structures such as jetties, groins, and breakwaters is generally limited, although in some cases slight modification of structures may increase their suitability for certain recreational activities. For example, jetties and groins often provide additional fish habitat and may become popular fishing spots and surfing areas. Provision for access, parking, and public safety can enhance their recreational potential. Modifications can be incorporated during the early design stage or retrofitted to existing structures.

(3) Lands. Project lands, whether purchased or created through disposal or accretion, have high and diverse recreation potential. They are especially attractive for shoreline recreation development such as swimming beaches, boat launching ramps, marinas, and fishing piers. Campgrounds, multiple-day use areas, and trail systems are appropriate where areas are of sufficient size. While high-intensity recreational use is generally dependent on facilities development, undeveloped project lands can support activities such as nature study, hunting, and beachcombing if sufficient access is provided. Where possible, recreational facilities should accommodate the handicapped. Table 3-1 outlines specific activities and required facilities for recreational use of Corps projects.

b. Recreation Design Considerations.

(1) Refer to EM 1110-1-400 and ER 1110-2-400 for guidance on design of recreation features. Additional information regarding land-based recreation and water-based activities is given by Nunnally and Shields (1985).

(2) Recreation facilities should be sized and located to avoid over utilization or underutilization, as well as conflicts with other authorized project purposes such as navigation. Refer to Urban Research and Development Corporation (1980) for methods to estimate carrying capacity. Over use often results in degradation of the natural resources. In addition, uncontrolled usage may impact the integrity of the shore protection project, particularly when dune or marsh vegetation is an integral part of that project. It is therefore necessary to assure adequate management to provide for optimum public use and maintain the natural characteristics and resource capabilities of the area.

3-7. Aesthetic.

a. General. Coastal shore protection projects affect aesthetic characteristics of the environment through changes caused by construction and maintenance activities, the presence of the coastal structures, and changes in public use patterns. Changes in public use patterns include the increased use of the coastal area for recreation or increased use of an area resulting from the protection afforded by the coastal structure. The aesthetic value of an environment is determined by the combination of landscape components, e.g., water resources, vegetation, and the perceptions and expectations for the resource user or visitor. Perceptions of aesthetic value encompass all of the perceptual stimuli in the environment, i.e., sight, scents, tastes, and sounds and the interaction of these. Visual perceptions are the most predominant of the senses, and visual changes are the major focus of aesthetic assessments. The visual environment for coastal shore protection includes terrestrial landscapes, shorelines, open-water channels, and waterways. Many coastal areas associated with coastal shore protection projects offer a high-value aesthetic experience.

b. Aesthetic Design Considerations. The assistance of a landscape architect should be sought for consideration of landscape design and aesthetic impact assessment. The landscape components of all environments can be manipulated, to some extent, to increase positive visual effects. The landscape components usually considered in water resource projects include landforms, water resources, vegetation, and use characteristics, e.g., recreation or navigation. Each of the landscape components has associated design elements that affect visual quality. The design elements are color, form, line, texture, scale, and spatial character. In considering the design elements, scale may be constrained more than the other properties because of its dependence on object size and the limitation on choice of size for most project features. Examples include the use of natural materials which possess colors, forms and textures that are more desirable than man-made materials, topographic modification of linear features to achieve a more irregular, natural appearing profile, and selection and placement of trees, grasses, and shrubs to improve compatibility of color, form, line, texture, and scale. Nonstructural alternatives, of course, provide high potential for maintaining or enhancing natural aesthetically pleasing conditions.

c. Aesthetic Impact Assessment. Potential visual impacts of proposed coastal projects or impacts at sites of existing projects can be assessed with a procedure such as the Visual Resources Assessment Procedures (VRAP) recommended to the US Army Engineer Waterways Experiment Station by the Department of Landscape, State University of New York, Syracuse. Aesthetic impact assessment involves determining the changes to the landscape components caused by a proposed project. The potential changes caused by changes in vegetation and water resources can be determined by project plans. Evaluating the future visual appearance of a project is

TABLE 3-1

Recreational Activities and Facilities<sup>1</sup>

Activities	Facilities
Beachcombing	Beach
Bicycling	Trail or road
Boat launching	Ramp and parking areas
Boat mooring areas	Mooring buoys, boat slips, breakwaters, wake absorbers, jetties, dredged channels, aids to navigation, etc.
Camping	Campground, trash receptacles restrooms
Fishing	Water access
Hiking	Trails
Hunting	Sufficient area and habitat and access
Jogging/running	Jogging and running trails and paths
Nature study	Nature area
Outdoor games	Multiple play area
Picnicking	Tables, trash receptacles, fireplaces
Sunbathing	Beach
Swimming	Suitable water and shoreline
Sightseeing	Scenic overlook or viewing tower projects
Surfing	Water access, suitable wave climate and shoreline orientation, and/or sand bars
Snorkeling and scuba diving	Water access and marine recreational or park areas including navigational aids

<sup>1</sup>/Where possible, all facilities should accommodate handicapped and wheelchairs.

most appropriately done by visual simulations, such as drawings or rendering on a photograph. Districts have a number of graphic capabilities that can be used for visual simulations. Assistance of a landscape architect should be sought for the aesthetic impact assessments.

3-8. Cultural.

a. General. Guidance on the need for identification and protection of significant cultural resources in a project area is provided in ER 1105-2-50. Cultural resources are the physical evidence of past and present habitation that can be used to reconstruct or preserve human history. This evidence consists of structures, sites, artifacts, and objects that may best be studied to obtain relevant information. Cultural resources found in coastal shore protection project areas provide physical evidence of how the areas were used for commercial and game fishing, navigation, agriculture, and other activities during historic and prehistoric periods. Identification and interpretation of cultural resource sites clarify the relationship between present-day use and past use. Protection of these historic properties is in the broad public interest as declared by Congress and should be identified, evaluated, protected, preserved, and managed. Cultural resource preservation is an equal and integral part of resource management and should be given equal consideration along with other resource objectives.

b. Coordination Requirements. ER 1105-2-50 requires all actions involving unavoidable effects on National Register or eligible historic properties to be fully coordinated with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP). It may also be desirable to establish and maintain coordination with state archaeologists, state and local archaeological or historical societies, and other state and federal agencies or institutions with special interests or expertise.

c. Cultural Resources Analysis. An analysis of the cultural resources of the project area is usually done during the planning phase to identify sites that require protection or mitigation due to their cultural significance. An analysis of cultural resources usually begins with a reconnaissance survey to determine whether sites are present and is later followed by an inventory of the cultural resource sites including their function and significance and an assessment of the potential losses or damages due to the project. Identification of sites is accomplished by professional archaeologists, often through interviews with local officials and residents, and by examination of archival materials such as the National Register of Historic Places, national architectural and engineering records, maps, and official records. The interviews and archival search delineate the density of sites and the types of sites present, i.e., prehistoric sites, historic sites, architectural elements, and engineering elements. The significance of each site is determined by criteria established by the National Register of Historic Places and by

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professional judgment. Loss or damage to sites from preliminary or potential project designs can be determined from an inventory and significance analysis, usually accomplished during the planning stage of the project as a result of an intensive archaeological survey. A management plan should be prepared for each applicable project consistent with current guidance to identify, evaluate, protect, preserve, and manage significant historic properties. A mitigation plan may be required when damage to significant resources is expected.

d. Cultural Resources and Design. Project designers should use the cultural resources analysis to develop designs that incorporate protection of the resources. compliance with historical preservation statutes is a significant determinant in developing the scope of studies and mitigation of impacts to significant resources. Preservation through avoidance of effects is preferable. Where avoidance of effects is impossible, protective measures incorporated in to project design must consider the nature and characteristics of the resource, site topography, and operation and maintenance requirements. Whenever a significant historic or archeological site is to be impacted, project design must proceed in consultation with the SHPO and ACHP in accordance with ER 1105-2-50 and 36 CFR Part 800. Project designers should consult Technical Report EL-87-3, Archaeological Site Preservation Techniques: A Preliminary Review (Thorne, Fay, and Hester 1987).